PROJECT MANAGEMENT FOR THE PRODUCTION PHASE OF SYSTEM ACQUISITION

Richard Herman Bergman

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

PROJECT MANAGEMENT

FOR

THE PRODUCTION PHASE

OF

SYSTEM ACQUISITION

Richard H. Bergman

Stephen S. Israel

March 1973

Project Management
for
The Production Phase
of
System Acquisition

by

Richard Herman Bergman
Lieutenant Commander, Supply Corps
United States Navy
B.A., St. Mary's College, 1958

and

Stephen Seabrook Israel
Lieutenant, United States Navy
B.S., United States Naval Academy, 1967

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
March 1973

ABSTRACT

Military project management for the Production phase of system acquisition is discussed. A management framework based on analysis of five principles--planning, organizing, staffing, directing, and controlling--is constructed. Organization alternatives for production management are proposed to the Aegis Weapon System Project Manager, who sponsored this research. The results of this analysis indicate that when a project manager's background is categorized as being operational, administrative or technical, significant conclusions can be drawn concerning the characteristics of the project manager best suited to manage the production phase and the structure of his production organization. Investigation also revealed that the primary functions of military project organizations in the Production phase of system acquisition are: Business Management, Systems Engineering, Production Control, Quality and Testing, and Fleet Support. Departmentation along these functional lines during the Production phase of system acquisition appears to reflect the economic division of work in the military project organization.

TABLE OF CONTENTS

I. INTRODUCTION

The objective of any management effort should be to create and maintain the internal environment for organized effort necessary to accomplish group goals. Regardless of the enterprise all managers adhere to common principles to accomplish this objective. These principles are planning, organizing, staffing, directing, and controlling [13]. The purpose of this paper is to discuss these five basic principles as they pertain to military production management. A Department of Defense (DOD) definition is as follows:

> "Production management can be defined as the art or science of effectively and efficiently utilizing resources such as men, money and machines to generate goods and services." [27, p. 3]

The need for research concerning organizational aspects of military production management was expressed to us by the Aegis Project Manager, the research sponsor. Analysis of available DOD and service references revealed a lack of guidance concerning organizing, staffing and directing a military production effort. For example, the Air Force Production Manual and the draft copy of DOD's Integration of Planning for Production address planning and controlling aspects of production; however, there was no attempt to present an integrated approach to production management based on all five principles of management. From this evolution of need was born the primary research objective--to propose a management framework, based on all five principles, for

production of major defense systems. There is also a secondary objective, to propose three organization alternatives for the Aegis Project staff. These will be presented as specific examples of management structure for the production phase of systems acquisition.

II. APPROACH

Section I, the Introduction to this paper, is designed to express the purpose of, need for, and objectives of this research. Section II, Approach, reveals the nature of the research and how this research led to the accomplishment of stated objectives. Section III, Background, consists of a brief history, system description, and current status report of the Aegis Weapon System. This information is useful to the reader as an example of how the need for a weapon system evolves and as an illustration of the complexity of today's new weapon systems. Following the Aegis description is a brief discussion of the traditional systems acquisition life cycle, which sets the stage for the primary analysis concerning the management of one of the phases--production. Section IV, Production Management Framework, is based on research of the five basic principles of management as they apply to the production phase of military weapon systems acquisition. Section V, Summary, is a listing of major conclusions.

The approach to organization of this thesis was to utilize the Aegis Project as a primary research example, relying heavily upon their staff expertise and experience. The specific organization alternatives proposed are intended for the Aegis Project Manager. However, because most weapon systems acquisitions experience a similar life cycle, the findings can apply to all military projects in the Production phase.

Research for this thesis included review of pertinent literature including basic management and production texts, military directives and instructions, and pertinent management periodicals and publications. Review of these references was accomplished in order to establish a firm understanding of the five basic management principles--planning, organizing, staffing, directing, controlling--and how these principles relate to production management of major defense systems. The literature also revealed several key theories pertaining to industrial management which applied to military production management.

To ascertain the perspective of a major support activity, the authors visited the Naval Ship Missile Systems Engineering Station (NSMSES) in Port Hueneme, California. This Naval support activity, now called the Naval Ship Weapon Systems Engineering Station, provides engineering, technical and logistic support for the Navy's Surface Missile System Project, the Systems Commands and the more than 70 ships of the SMS Fleet. The Station provides or performs the following major services and functions in the surface missile system field:

--technical documentation
--configuration control
--design and development
--reliability analysis
--underway replenishment
--ship assistance
--overhaul support
--integrated logistics support
--contracts management
--technical support for training [31]

Many of these functions will be performed and monitored during the Aegis Production phase. Interviews were conducted with the Commanding Officer of the Weapon Station and with the representatives of the Aegis, Terrier, Tartar, and Talos missile projects. The latter three interviews were conducted in order to gain an appreciation of the production management problems encountered by the three major missile systems which preceded the Aegis Weapon System concept.

During the initial trip to Washington, D.C., interviews were conducted with project managers or key personnel from seven Navy projects currently in production. From this information the authors derived an initial list of functions necessary to management of the Production phase of systems acquisition. These projects were:

Naval Air Systems Command

1. S-3A
2. E-2C
3. VAST

Naval Ordnance Systems Command

4. Aegis
5. Terrier, Tartar, Talos
6. MK-48 Torpedo

Naval Ship Systems Command

7. DD-963

During a follow-up research trip, the authors visited the Aegis prime contractor, RCA at Moorestown, New Jersey. Interviews were conducted with the Defense Contract Administration Services (DCAS) Representative, the Naval Ordnance Technical Representative, and one of RCA's vice-presidents

in charge of the Aegis Project. Additional interviews were held in Washington with personnel from the Aegis Missile and the MK-48 Torpedo projects. Higher management opinion was sampled by interviews with Commander, Naval Ordnance Systems Command; Deputy Chief of Naval Materiel (Procurement and Production); and assistants to the Deputy Assistant Secretary of Defense (Production Engineering and Materiel Acquisition). The purpose of these follow-up interviews was to gain additional practical information, to verify initial conclusions, and to obtain opinions on a project organization structure prepared from information gathered during the first visit to Washington, D.C.

In summary, 32 interviews were conducted as a result of two trips to Washington, D.C.; one trip to Moorestown, New Jersey; and one trip to Port Hueneme, California. Information received concerning production management was representative of a broad spectrum of opinion and experience ranging from the field activity to the Department of Defense, with emphasis on the military project organization for managing a production effort.

The authors acknowledge with appreciation the participation and contributions of the above mentioned individuals and organizations and express their gratitude to the Aegis Project Manager, Captain Wayne E. Meyer, and his staff for sponsoring this research.

III. BACKGROUND

A. AEGIS WEAPON SYSTEM

The following material, condensed from several Aegis Project brochures, provides an example of the evolution of a new weapon system. It illustrates the long time required for research and development and the complexity of today's modern weapon systems.

The Navy entered the guided missile field in the closing months of World War II, when an improved defense against the high-speed, high-altitude Japanese kamikaze attacks became essential. The missile program was given the name "Bumble-bee." A task force of scientists and engineers began work that was to culminate in the development of three operational surface-to-air-missiles: Terrier, Tartar and Talos. These three missile systems became the primary armament of the Navy's guided missile ships.

Talos is powered by a solid-propellant booster and a ramjet sustainer. The small, solid-propellant missile used initially to test Talos guidance and control was itself produced as a tactical, medium-range, anti-aircraft weapon known as the Terrier. Further research permitted the combining of booster and sustainer rockets into a single engine--this outgrowth was named Tartar. The 3-T's became operational in the late 1950's and early 1960's. Further research into surface missile systems has produced the Standard Missile

(SM-1). This modular missile system is interchangeable with Terrier and Tartar and produces a greater capability for both of these weapon systems.

In anti-aircraft warfare since World War II, surface defense was delegated to ships with Terrier, Tartar and Talos missile systems. Air defense was delegated to the F-4 aircraft with the Sparrow Missile System. As time passed there emerged to replace these two lines of defense the F-14 aircraft armed with the Phoenix missile system, and for surface ships the Advanced Surface Missile System now called Aegis. These are the only two anti-air defense acquisition efforts in the Navy for protection of the fleet in the future.

Naval forces in the 1980's and beyond will contend with a new generation of more sophisticated airborne threats and advances in electronic warfare techniques. Aegis is the advanced weapon system that will replace the 3-T's and counterbalance these advanced threats. It is an all-weather fleet defense missile system for use against multiple attacks by aircraft, air-to-surface and surface-to-surface missiles, and surface targets in a rigorous electronic counter-measures environment. Aegis protection will be focused over an expanse of ocean to provide area defense for any major naval force. In effect, Aegis surrounds the task force with a wavetop-to-stratosphere dome of defensive firepower.

Designed primarily for installation in frigates and destroyers, the system will have greatly reduced reaction time, unprecedented firepower, high reliability and

availability, high resistance to electronic counter-measures, and the ability to function effectively in adverse weather. Ships equipped with Aegis can coordinate defense with Tartar, Terrier, and other Aegis ships, helping to identify optimum targets for each of the less capable systems. Aegis radar data also can be employed to direct and control friendly aircraft who engage the enemy in air-to-air combat.

Key components of the system are: 1) an electronically scanning Phased Array Radar for automatic search and track, and missile mid-course command guidance; 2) a Weapon Direction System which evaluates, schedules and assigns weapons to target engagements; 3) the multi-purpose missile launcher which launches anti-air, anti-surface and anti-submarine weapons interchangeably; and 4) the new Standard Missile (SM-2) which will be the primary missile used for this system.

As of this writing, the first Engineering Development Model (EDM-1), a major milestone, is nearing completion. EDM-1 is about one quarter of the total Aegis system. The EDM-1 will be factory-tested in a carefully controlled land-based test site and then installed in USS NORTON SOUND (AVM-1). Upon completion of the first at-sea performance tests, EDM-1 will be reconfigured for further testing. Three successful test firings of the Standard Missile (SM-2) have been conducted at the White Sands Test Facility in New Mexico. Full-scale production of the Aegis Weapon System is scheduled for the late 1970's or early 1980's.

B. MAJOR DEFENSE SYSTEM ACQUISITION LIFE CYCLE

As implied in the history of the Aegis Project, a new weapon system life cycle begins when the military services are required to replace aging models or counter new enemy threats. The purpose of this section is to briefly describe terms and phases of the systems acquisition life cycle, to illustrate how the Production phase fits into the cycle, and to set the stage for discussion of production management.

A generally accepted definition of a system is:

> "a regularly interacting or interdependent group of items forming a unified whole."

Thus a system may have many components and objects (materials, information, machines, people, etc.) but they are united toward some common goal. In addition, a change in one variable within the system will effect the other system variables. [19, p. 39]

In order to cope with advanced technology and the complexity of modern weapon systems, the Department of Defense recognized the need for improved management techniques. The success of the initial attempt at project management caused all services to expand their use of the concept for an increasing number of weapon systems. By 1965, sufficient experience had been established by the military services to convince the Secretary of Defense that acquisition of all major weapons should be controlled by this form of management. [37, p. 22]

The weapon system concept emphasizes the importance of timely integration of all aspects of a weapon or support system, from the establishment of operational requirements through deployment. A weapon system, as contrasted with the weapon itself, is a total entity consisting of an instrument of combat, such as a bomber or an inter-continental ballistic missile, together with all related equipment, facilities and personnel. [11, p. 117]

The acquisition of a weapon system occurs in several overlapping phases, each made up of specific functions and activities, which comprise the acquisition life cycle. This cycle begins with Program Initiation and progresses through Full-Scale Development, Production and Deployment.

1. Program Initiation Phase

This is the initial phase in the system life cycle. It usually extends from the inception of the system through the first three to five years of its life. During this phase, the need for the system is verified, system concepts are formulated, and their feasibility and worth are established. [34, p. 2-4]

Three major decisions must be made early in this phase:

1. Is the mission feasible?
2. What is the best approach for performing the mission?
3. Is further development of the best approach justified? [34, p. 2-7]

As a result of these decisions the Research and Development (R&D) effort on the weapon system will be extended or the

program will be dropped. Each alternative is analyzed for its technical, economic and financial feasibility. If R&D is continued, tradeoffs are made between capability, risk and effectiveness.[34, p. 2-12] From these tradeoffs and further analysis, a system concept is born and basic policy, organization and resource requirements are conceived. The product of this phase is a set of system requirements which provide a basis for continued evaluation in the Development phase. [7, p. 152]

2. Full-Scale Development

The primary objective of full-scale development is to complete sufficient R&D effort to allow a confident commitment of resources to production.[40] The products of this phase are a preproduction system which closely approximates the final product, the documentation necessary to enter production, and the test results which demonstrate that the final product, as distinguished from a handmade test model will meet stated requirements. Admiral Roland Freeman, current Deputy Chief of Naval Material (Procurement and Production), warned project managers about accepting results of tests conducted on handmade or preproduction hardware as being proof that systems from the production line will meet the Navy's specifications. The Development phase allows time for the service to fully define and test the system prior to committing resources to production.[7, p. 152]

In summary, full-scale development implies detailed specifications, development, test and evaluation, and in

certain cases limited pilot production, of the total system--including those items necessary for Integrated Logistic Support (ILS). Following full-scale development is the Production phase of the system life cycle. Management of this phase, Section IV, is the main topic of this paper.

3. Production Phase

When the Navy is sufficiently confident that engineering development is complete and that commitment of substantial resources to production is warranted, it will again review the program and forward its recommendations concerning production to the Secretary of Defense for final decision. Such review will confirm the need for producing the weapon system based on consideration of the threat, the estimated acquisition and ownership costs, and the potential benefits in the context of overall DOD strategy and fiscal guidance. In addition, this review will confirm that a practical engineering design, with adequate consideration of production and logistics problems, is complete; that all previously identified technical uncertainties have been resolved; that operational suitability has been determined by test and evaluation; and that the plan is realistic for the remainder of the program.[40]

After the Secretary of Defense has given his approval, the Production phase will officially begin. The objective of this phase is to produce and deliver a system with support equipment which meets cost, schedule and performance specifications. To accomplish this objective an integrated plan

for production must be established which addresses such elements as producibility analysis and manufacturing requirements. Execution of the production plan will encompass additional facets such as production engineering, quality assurance, standardization, system safety, configuration management, industrial property and mobilization base, priorities and allocations, production surveillance, labor relations, and international acquisition.[40]

Before the system is introduced into the fleet, modification to the facility (e.g. ship, aircraft) is completed. Additional logistics planning is done to ensure that necessary support equipment and supplies are available on schedule. The installed system is then tested and checked out for user acceptance.[34, p. 2-24]

The system now exists for the first time as a complete usable entity with all its required resources--prime equipment, support equipment, facilities, trained operating and maintenance personnel, supplies and repair parts, and operating and support data.[34, p. 2-25] This phase probably requires more planning than any other phase because all subunits are incorporated into an integrated weapon system. The heart of this paper, Section IV, Production Management Framework, contains further detail on planning for production.

4. Deployment Phase

The Deployment phase of weapon systems acquisition is that long period of time when the system is operated to fulfill its mission requirements.[34, p. 2-25] This phase consists of those activities required to operate, support and maintain the system, including periodic improvement to meet changing requirements and to prolong its life cycle. [34, p. 2-6]. The latter effort is called "sustaining engineering."

During this phase some problems with the system, that were not previously encountered, may surface. These serve as a basis for engineering changes.

Finally, when the system no longer proves to be cost-effective for meeting operational requirements, it is retired. Retirement leads to the generation of new system requirements and the system life cycle starts over again.[34, p. 2-25]

IV. PRODUCTION MANAGEMENT FRAMEWORK

In Principles of Management, An Analysis of Managerial Functions, Koontz and O'Donnell list five basic principles which a manager adheres to if he is to obtain effective performance from his organization. These principles are planning, organizing, staffing, directing, and controlling. The following section addresses these principles and attempts to combine management theory with the characteristics peculiar to military system acquisition. The resulting management framework is the primary objective of this study.

A. PLANNING

Planning for production is an extensive process and is the first plank in the framework.

> "Planning is the selection from among alternatives of future courses of action for the enterprise as a whole and each department within it."[13, p. 81]

Prior to discussion of the major elements of production management which require plans, it is useful to list the logical steps to the planning process. They are as follows:

1. Set planning objectives
2. Establish premises
3. Determine alternative courses
4. Evaluate alternative courses
5. Select a course
6. Formulate derivative plans

By following the above steps, described in detail by Koontz and O'Donnell, the project manager can construct an integrated plan for production.

In 1968 the Logistics Management Institute (LMI) undertook a study, TASK 68-14, to determine and author a guide for integration of production planning, at the request of the Assistant Secretary of Defense (Installations and Logistics). This document presents eight major areas of concern when planning for production. To improve on this study, a synopsis of these planning areas is presented below and additional planning areas are addressed. Definitions and explanations of the first eight areas of production planning are summarized from the draft copy of the Department of Defense's 1969 guide to Integration of Planning for Production and the Air Force Systems Command manual 84-3, Production Management, of 14 May 1971.

The areas are:

1. Producibility analysis
2. Funding
3. Inspection and testing
4. Equipment and tools
5. Industrial support
6. Facilities
7. Personnel and training
8. Data
9. Configuration control
10. Fleet support

Producibility analysis is a composite of production planning and designing, which when applied to the management of a production item, will result in a more effective and efficient means of manufacturing, testing and installing systems. Producibility analysis includes tradeoff studies in the consideration of materials, tools, test equipment, facilities, personnel, and manufacturing procedures which support the Production phase of acquisition.

Funding analysis deals with the interface between production funding requirements and defense budgeting and financing. More simply, it is the process of tradeoff analysis between the optimal producibility plan, fiscal requirements, and project budget limitations. This plan is continually updated to reflect revised funding requirements.

The inspection and test plan is the instrument by which the project manager can identify and correct production engineering practices which would otherwise lead to unsatisfactory materials, parts, subassemblies, and assemblies. This plan will identify alternatives and establish the overall inspection and test concept which will provide the project manager with assurance that the manufacturing processes will produce equipment which meets system specifications.

Equipment and tool analysis is a determination of the best mix of machinery, tools, handling and test equipment, jigs, dies, and fixtures necessary to support the entire production process. The objective of this analysis is to assure the availability of required equipment and tools to perform manufacturing functions at the lowest possible cost during the Production phase.

Industrial support analysis is that element of production planning which deals with the timely allocation of production materials and resources required for acquisition of the system. The plan defines requirements in detail and establishes general policy for coordination of industrial support.

Facilities planning is concerned with types of facilities which are necessary to house the production effort. Specifically it concerns locations of facilities or space needs for the manufacturing process and the environment in which production will be accomplished.

Personnel and training is an area of production planning which deals with the identification and programming of all skills, personnel, and training requirements necessary to sustain a production effort. Personnel requirements are established by the service, the government and the contractor; then they are evaluated against manpower assets.

Planning for the collection, programming and distribution of data is an essential function for technical and management control of a system acquisition project. Data provides the input for performance, configuration, cost, and schedule control systems such as those required in DOD Instruction 7000.2. In planning which data to collect it is necessary to determine where, when, how and by whom the data will be needed.

The configuration control plan is concerned with applying technical and administrative direction and surveillance to (1) properly identify functional and physical characteristics of an item, (2) identify and control changes to those characteristics, and (3) record change processing and implementation status throughout the life-cycle of the system.

The final planning area, fleet support, covers the plan for installing the new system in the fleet and Integrated

Logistics Support. Planning for installation involves close coordination between the project office, contractor, installation facility (e.g. shipyard), and the receiving unit (e.g. a ship). The many facets of ILS--spare parts, trainers, support equipment, packaging, etc.--require detailed planning throughout the system life cycle.

Responsibility for these planning areas is assigned to the appropriate functional managers, whose task is to generate specific plans and to establish requirements for the Production phase.

In order to carry out plans, and make it possible for the project staff to work effectively, an intentional structure of responsibility and authority must be designed. This is the topic of the following section.

B. ORGANIZATION

> "Organizing is the grouping of activities necessary to accomplish goals and plans, the assignment of these activities to appropriate departments, and the provision for authority delegation and coordination."[13, p. 227]

The following discussion of organization theory will include identification of production functions, principles of charting, span of control, and the dual management concept. Research indicated that although emphasis varied, departmentation of production functions was common to all seven military project organizations consulted. From interviews the authors identified the following functions which appear to reflect the economic division of work and to

contribute directly to the achievement of the production objective:

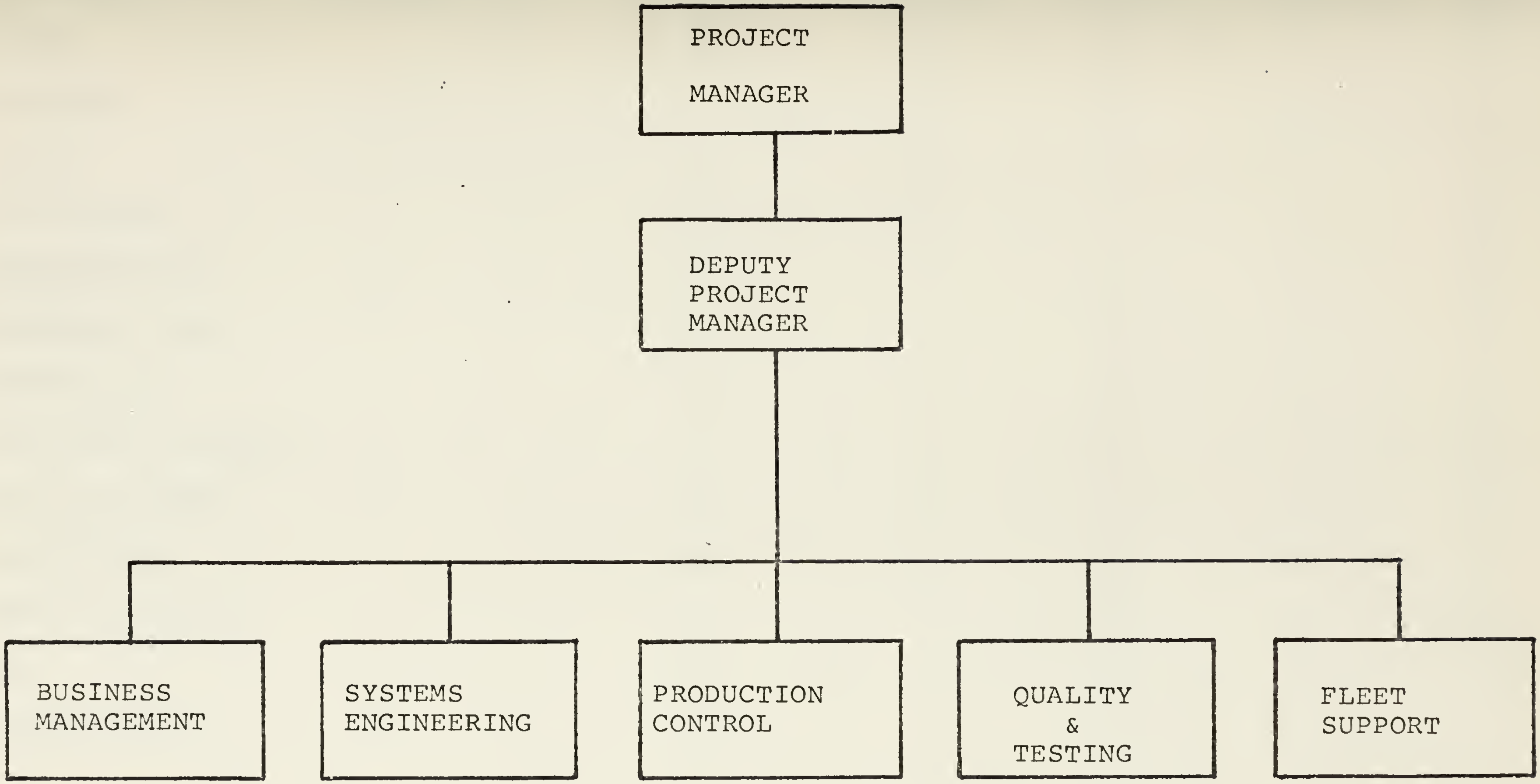
1. Business Management
2. Systems Engineering
3. Production Control
4. Quality and Testing
5. Fleet Support

The Business Management function encompasses planning, programming, budgeting and procurement. Systems Engineering is responsible for the engineering aspects of the system; in particular, configuration control. The Production Control function directs and controls all aspects of the manufacturing effort. The Quality and Testing function includes the quality control program and the inspection and test plan necessary to ensure that the equipment meets system specifications. The Fleet Support function is mainly concerned with the Integrated Logistics Support Plan and fleet introduction of the system. Detailed descriptions of these functions are included in Appendices A through E, which were compiled using position descriptions obtained from the seven project offices visite (These offices are listed in Section II of this thesis.) Appendices F and G are included to describe two additional functions designed specifically for the Aegis Project staff. None of these appendices is intended as an all-inclusive job description, but rather as an example of major duties and responsibilities.

To propose Aegis Project organization alternatives, a graphic representation of the formal organization structure is required. This graphic display or chart is used to show

organization, functional relationships, and lines of authority and responsibility.[16, p. 87] An organization chart is useful in that it provides a general structure of the organization. However, its greatest value may be the analysis required for its preparation. The creation of the chart is itself a way of forcing planning and analysis.[8, p. 192] However, organization charts such as Figure 1, do not display the manner in which the daily tasks of the organization are performed. The linear responsibility chart (LRC), Figure 2, is an attempt to reveal the task-job relationships which exist in the organization; however, the formal structure is not apparent. In an attempt to eliminate the shortcomings of the organization chart and the LRC, the authors developed a new charting technique called the organization responsibility chart (ORC). This chart, Figure 3, displays the formal organization structure and also indicates the basic task-job relationships. Complex organization structures can be displayed in this manner via the utilization of more sophisticated drafting techniques.

One type of information that can be gained from organization charts is span of control. In organization theory, span of control is the number of people that one person can supervise directly.[19, p. 37] Often this concept is stated in terms of the exact number of subordinates that should report to a superior. However, factors such as delegation of authority, time, training, planning, and personal characteristics cause the optimum span of control to vary between



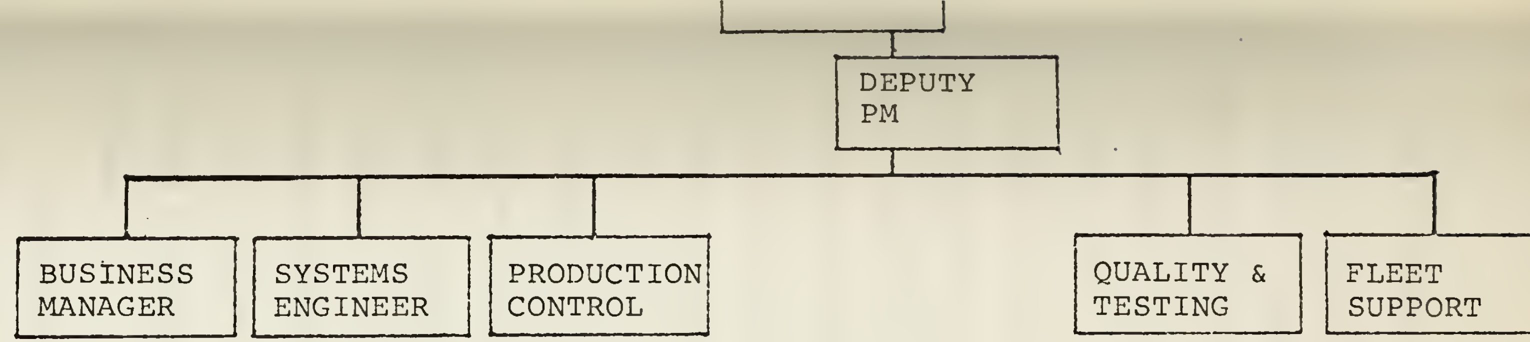
PRODUCTION ORGANIZATION CHART

Figure 1

(R) RESPONSIBLE (C) CONSULT (N) NOTIFY	PROJECT MANAGER	DEPUTY PM	BUSINESS MANAGEMENT	SYSTEMS ENGINEERING	PRODUCTION CONTROL	QUALITY & TESTING	FLEET SUPPORT
PLANS	C	C	R	C	C	C	C
PROGRAMS	C	C	R	C	C	C	C
BUDGET	C	C	R	C	C	C	C
PROCUREMENT	C	C	R	C	C	C	C
CONFIGURATION	N	N	C	R	C	C	C
TECHNICAL DATA	N	N	C	R	C	C	C
MAINTENANCE	N	N	N	R	C	C	C
PRODUCTION CONTROL	C	C	C	C	R	C	N
QUALITY CONTROL	N	N	N	N	C	R	N
INSPECTION	N	N	N	N	C	R	N
TEST & EVALUATION	N	N	N	N	C	R	N
ILS	C	N	N	C	C	C	R
INSTALLATION	N	N	N	C	C	N	R

LINEAR RESPONSIBILITY CHART (LRC)

Figure 2



	BUSINESS MANAGER	SYSTEMS ENGINEER	PRODUCTION CONTROL			QUALITY & TESTING	FLEET SUPPORT
PLANS	R	C	C	C	C	C	C
PROGRAMS	R	C	C	C	C	C	C
BUDGET	R	C	C	C	C	C	C
PROCUREMENT	R	C	C	C	C	C	C
CONFIGURATION MANAGEMENT	C	R	C	N	N	C	C
TECHNICAL DATA	C	R	C	N	N	C	C
MAINTENANCE	N	R	C	N	N	C	C
PRODUCTION CONTROL	C	C	R	C	C	C	N
QUALITY CONTROL	N	N	C	N	N	R	N
INSPECTION	N	N	C	N	N	R	N
TEST & EVALUATION	N	N	C	N	N	R	N
ILS	N	C	C	C	N	C	R
INSTALLATION	N	C	C	N	N	N	R

ORGANIZATION RESPONSIBILITY CHART (ORC)
Figure 3

individuals.[15, p.68] For example, if the project manager feels he is adequately trained for both the technical and managerial aspects of his project, he may be unwilling to delegate authority to lesser managers. This tendancy increases the project manager's span of control by increasing the number of people he will supervise directly. From this example it appears that a project manager's background may affect the structure of the organization.

Interviews revealed that top military production managers could be categorized by background as either technical, operational or administrative. For the purpose of this paper, those with technical background include specialists such as the Ordnance Engineering Duty Officer, whose training generally has been confined to technical education. Those with operational background include the general line officer (air, ships, submarines) whose education and training includes a mix of technical and administrative experience. Those with administrative background are the Supply Corps officers and other officers whose primary education and experience have been in the business or administrative side of the Navy house.

The following are three production organization alternatives which reflect the project manager's background as categorized above. The first alternative is designed for the operational project manager, whose background is theoretically both administrative and technical. His organization shows an even distribution of his authority over and responsibility

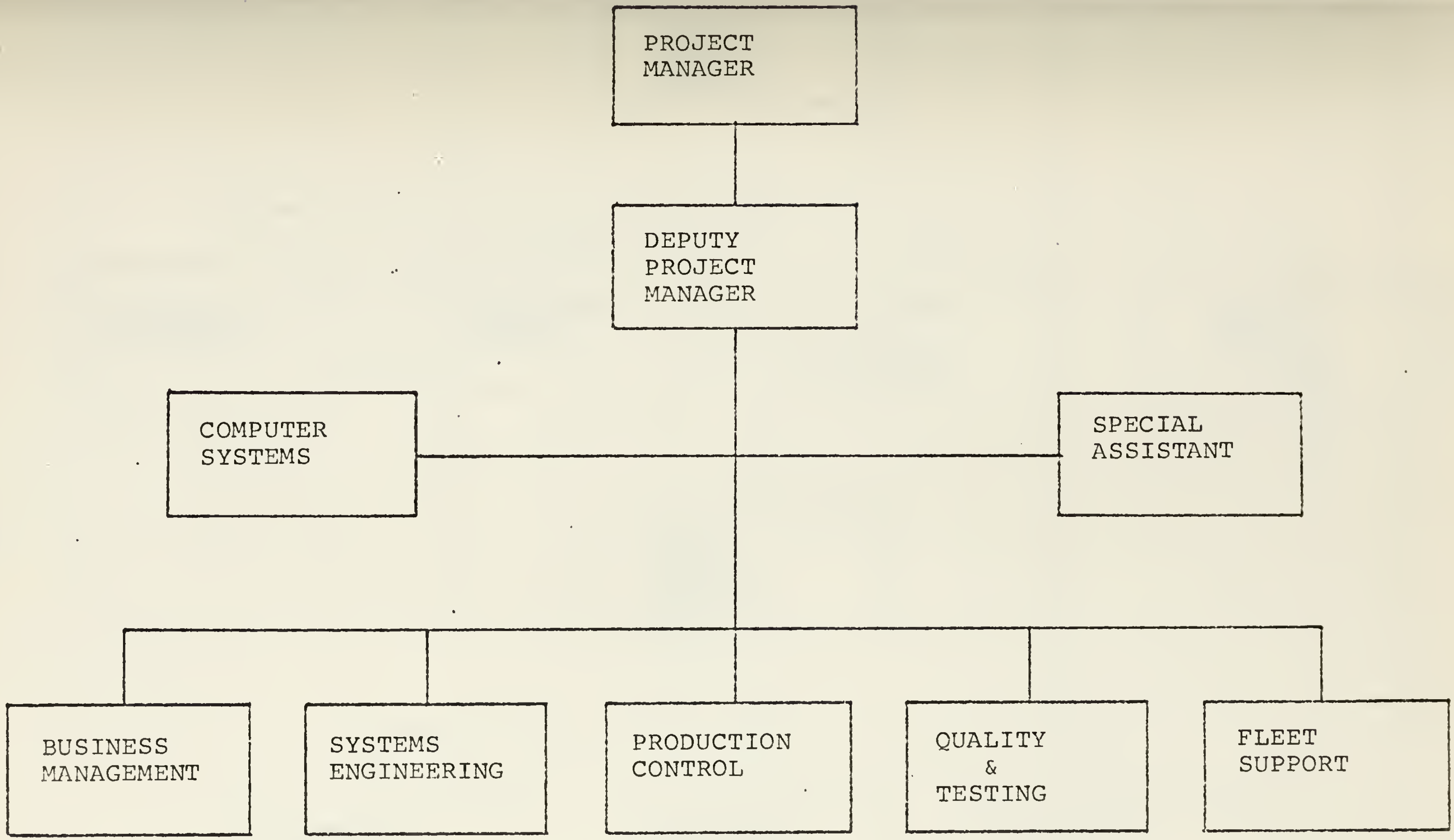
for the production functions. This organization structure was found to exist in the MK-48 Torpedo project which is currently in production, (Figure 4.)

The second and third alternative organizations (Figures 5 and 6) are designed to correct situations in which a project manager is relatively inexperienced in either technical or administrative areas. The management authority is divided between the project manager and his deputy. However, the project manager remains the single individual responsible for planning, organizing, staffing, directing, and controlling the program. In his article, "The Co-manager Concept," Senger states that:

> "A survey of naval officers who served in 312 separate commands during their careers revealed that in 60 percent of the cases the task and social functions were divided between the commanding officer and the second in command." [22, p. 79]

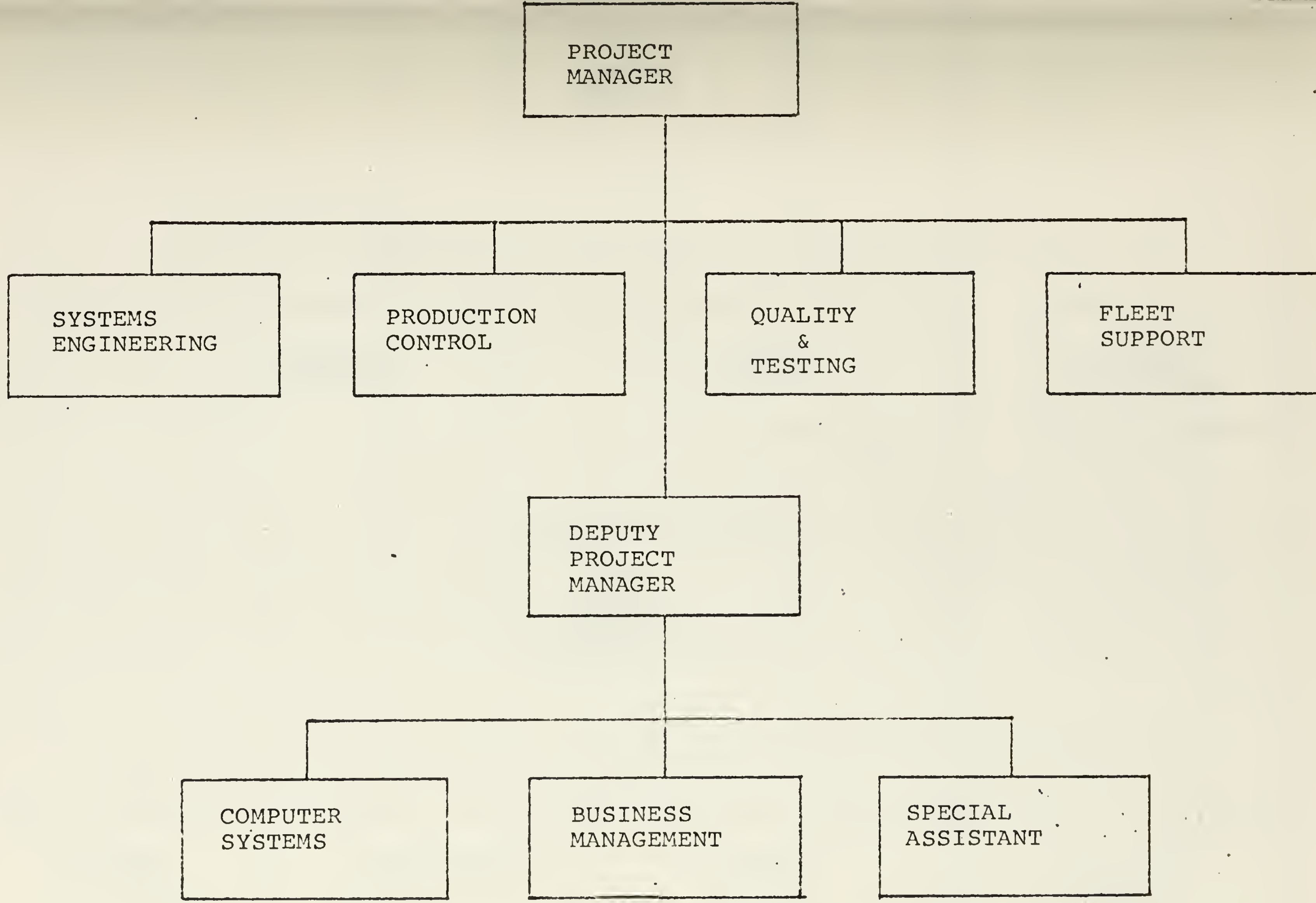
In the world of project management, technical and administrative functions roughly parallel the task and social functi n definitions as presented by Senger.

This dual or co-management system could maximize the u e of a project manager's expertise in a specialized area--administrative or technical--while it would prevent his lack of experience in the complementary area from decreasing the effectiveness of the organization. It would appear that by using one of these alternatives (Figures 4, 5, or 6) a project manager of any given background--operational, technical, or administrative--could construct an effective production management organization.



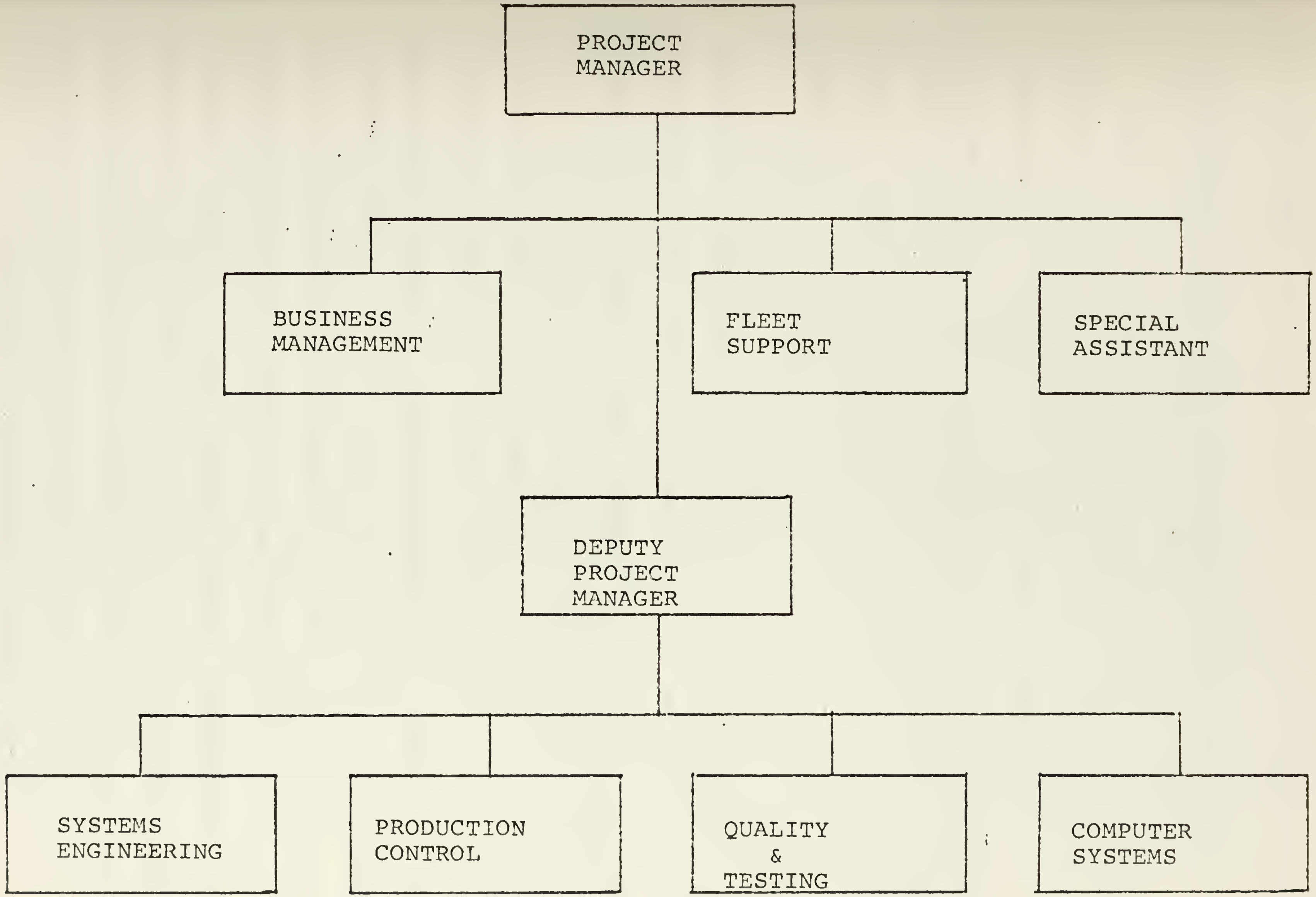
"OPERATIONAL" PROJECT MANAGER ORGANIZATION

Figure 4



"TECHNICAL" PROJECT MANAGER ORGANIZATION

Figure 5



"ADMINISTRATIVE" PROJECT MANAGER ORGANIZATION

Figure 6

C. STAFFING

> "Staffing is the executive function which involves the recruitment, selection, compensating, training, and retirement of subordinate managers." [13, p. 442]

Koontz and O'Donnell describe the objective of managerial staffing as ensuring that organizational functions are assigned to personnel who are willing and able to carry them out. The staffing process consists of several steps which together explain the method by which staffing is efficiently accomplished. They are development, job definition, appraisal, and promotion.

The first step is development, or striving to improve managerial competence. An effective management development program for the military can be viewed as having three main avenues of approach. The first approach is practical experience. Since experience is considered more important than formal training, current approaches to manager training are designed to emphasize practical experience.[13, p. 507] The second approach is aimed at improving the abilities of existing managers in their present positions. For example, the project manager may establish a training program in which inexperienced staff members of one discipline attend lectures or short courses in other areas of project management in order to broaden their educational backgrounds. The more experienced managers might participate in such a program to refresh and update their knowledge of particular subjects. The third approach to management development is aimed at future

management needs. This approach involves providing future managers with a basic education in the fundamentals of project management early in their careers, as is done in the System Acquisition Management curriculum at the Naval Postgraduate School, Monterey, California. Subsequent career development might include tours of duty in those billets related to the acquisition of major defense weapon systems and additional refresher courses in project management such as those offered at the Defense Management School, Fort Belvoir, Virginia. In summary, management development concerns first and foremost practical experience, second, improving the abilities of existing managers, and third developing managers for the future needs of the service.

Clear job definition is a basic requirement of an effective staffing program.

> "Specifications for the job rest on the need for results from plans, the requirement of a clear structure of roles, and the provision for incentives to induce efficient and effective performance."[13, p. 531]

Of the seven project offices visited, job descriptions for naval officers were almost nonexistent and position descriptions for civil service staff members often did not reflect their current duties and responsibilities. On the other hand, the business manager for the MK-48 Torpedo project had constructed a linear responsibility chart (LRC) which clearly defined his job in terms of actual tasks to be performed. This method of defining, for example, the business manager's job insured that his ideas of the business role for the MK-48 Torpedo project were consistent with and supportive of objectives set forth by the project manager.

Having an effective manager development program and clear job definitions is to no avail if the project manager cannot determine which of his managers perform well or poorly. This determination,

> "whatever the specific procedures may be, [is] intended to help the person being appraised or reviewed to do a better job. To obtain the benefit he must find out where he is weak. Unfortunately, both evaluator and evaluated have often approached this task queasily."[12, p. 371]

However, the project manager can establish a plan for periodic appraisals with the purpose of improving the efficiency of subordinates. To complement these appraisals, the annual review is conducted to measure overall efficiency at a given time. For example, the project manager may concentrate each appraisal on only one or two functions of the subordinate manager, whereas the annual review evaluates his overall performance. Such a plan requires appraisal of a subordinate's performance in terms of verifiable objectives and must address the quality of managing. [13, p. 491] Appraisal is the means by which the project manager can determine the final step in the staffing process--promotion.

The project manager who is objective in allowing promotions from within as well as outside the organization, gives the project team the opportunity to secure services of the best qualified people. He eliminates the complacent atmosphere which often sets in when managers only promote from within the organization. [13, p. 531]

In industry, executive promotion can be characterized as follows:

> "The road to top management in industry has normally been through one of three main functional areas: production, marketing, or finance. The organizational structure frequently reflects the functional orientation of the president. Different leaders given the same objectives will in all probability adjust the organization's structure to coincide with their views on how to attain goals." [16, p. 81]

This statement suggests that categorizing a project manager's background as administrative, operational or technical could contribute to planning the organizational structure, and that the staff could be chosen to complement the project manager's background. In other words, he could staff his organization to minimize or cover his weaknesses and take full advantage of his attributes. However, a fault of this suggestion is that few people realize their shortcomings. A technically oriented project manager would tend to choose a technical staff. Questionnaires to project managers, on education background needed to perform as a project manager, indicated that in most cases the project manager responded that the best background was "the one I have."[1]

---

[1] Benjamin E. Allen, Jr. and Thomas J. Loftus, "Career Development of Navy Project Managers" (unpublished Master's dissertation, Department of Operations Research and Administratvie Sciences, United States Naval Postgraduate School, Monterey, California. This information was gathered from a survey of 175 naval officers associated with system acquisition management, January, 1973.)

In a recent study concerning the authority and responsibility of the program manager, the Logistics Management Institute observed that:

> "Many of the 'matrix' program management organizations are very thinly staffed--with minimum ability to push program requirements through supporting organizations. Functional organizations, in some cases, do not appear to have come to grips with reality of program management concepts. A reduction in the number of programs would reduce extraordinary demands on functional organizations and might also permit a more liberal staffing of matrix program offices; a more extensive use of collocation of supporting functions (specialists) could also do much to alleviate problems created by sparse staffing of program offices."[29, p. IV]

This observation highlights the need for the project manager to constantly seek out qualified personnel and win support in the functional organizations. In the dynamic environment of project management, with its associated manpower fluctuations, subordinate development, job definition, appraisal and promotion are important principles which together contribute to an explanation of the method by which staffing is efficiently accomplished.

D. DIRECTING

Directing is the process by which actual performance of subordinates is guided toward common goals. Directing involves guiding, supervising, motivating and communicating with subordinates in a coordinated effort to operate the management system.[13, p. 535] The idea is to put into effect the decisions, plans and programs that have been worked out previously for achieving the goals of the organization. Many consider this principle to be the heart of management because

in directing, action is initiated. To direct subordinates a manager must motivate, communicate and lead. The main elements of the directing principle--motivation, communications, and leadership--will be discussed in this section.

In order to elicit superior performance, innovation, and creativity, managers are continually faced with the problem of motivating their subordinates. In order to motivate, the needs of these subordinates must be understood. Motivation can be then inspired by providing or withholding satisfaction of these needs with the purpose of achieving the desired level of performance.

Although a complete understanding of human needs does not exist, social scientists have suggested numerous lists. Abraham Maslow states the higher order needs do not become important until the lower order needs such as hunger are relatively well satisfied. The order runs from hunger to self-actualization. Studies conducted by Frederich Herzberg indicated the importance of the higher order needs. David McClelland believes that need achievement motivates people. The person who is high in need achievement is one who is likely to be concerned about the accomplishment of his task under any conditions. These are examples of the more widely held theories concerning human needs.

But how does a program manager motivate his people and understand their needs? There is no standard answer. Koontz and O'Donnell suggest that a system of motivation is required. The manager should build this system of motivation based on

satisfying common needs, keep it consistent with his experience with men, and keep it flexible enough to respond to variations in individual reactions.[13, p. 577]

The vehicle supporting the directing principle is communication. This element deals with the exchange of facts, ideas, opinions or emotions by two or more persons in an understandable form. In dealing with communication the needs of the organization must be known and communication barriers (e.g. filtering, distortion, etc.) must be recognized.

To assist the manager in overcoming these barriers, there are four principles to guide him.

1. Clarity--communicate in commonly understood language
2. Attention--give full attention to receiving communications
3. Integrity--make communications support organizational objectives
4. Strategic use of the informal organization [13, p.601]

In addition to applying these principles, the manager should be aware of other facets of communication--choice of techniques available, the difficulties of lateral communication between departments, and the problems of oral and written communication. Even though the manager is aware of these principles and barriers, communication problems invariably surface and are a constant challenge to the project manager's ingenuity.

Several good examples of the use of communication techniques by a project manager were found in the Aegis Project Office. The project manager holds regularly scheduled

meetings in which personnel from all levels in the organization participate. In this manner personnel become familiar with problems of all disciplines. While these meetings indeed take time, they are a most effective means of getting people to communicate.

This office also publishes a monthly Aegis Newsletter which highlights system progress and recognizes individual contributions to the program. In addition numerous posters and signs concerning the program are prominently displayed throughout the office spaces. The Newsletter and posters not only improve communications but they also aid in motivating the personnel. The people on the project staff are able to identify with the program and hopefully to develop a sense of pride in their work.

The last element of directing to be discussed is leadership. A large amount of research has been directed toward finding the characteristics of leaders that are most effective. Different leadership styles have been identified and provide a framework from which a manager can determine his own approach to directing.

The three commonly accepted styles of leadership--autocratic, democratic and catalytic--have been described and portrayed in the film "Patterns of Management" by Dr. J. Sterling Livingston. An autocratic manager is a high pressure individual who tends to rely on his authority. He is very dominant and self-reliant. Over the short run, this type of manager achieves impressive results. However, over

the long run, the high pressure manager achieves less and less impressive performance from his subordinates.

The opposite of the high pressure manager is the no pressure or democratic manager. This type of manager is tolerant and trusting. He does not try to force people. He relies on the self-direction and self-control of his subordinates. Over the short run, these managers achieve unimpressive results, but over the long run they often become excellent performers.

Somewhere in between these two is the catalytic manager. He initiates action and involves his subordinates in that action. As his subordinates increase their capabilities, he decreases his own involvement. The catalytic manager acquires his style through experience. He usually produces excellent results in both the long and the short run.

Despite the fact that to date studies have failed to show a significant relationship between leadership styles and performance, our research results tend to suggest that in the initial phase of the life cycle, when the formal organization is sketchy, an autocratic project manager may be best equipped to get the system moving. A possible issue for further research might be a new look at leadership styles to determine if any of them are best suited to management of particular phases of the system life cycle.

Although leadership is a personal trait, the above styles could be analyzed by a project manager so that he may develop and adapt his style to the situation in which he finds

himself. The project manager's goal, regardless of his style of leadership, is to direct his subordinates toward the accomplishment of production objectives. This leads to the last principle, controlling, for there must be some means of measuring and correcting performance of subordinates.

E. CONTROLLING

> "Control is the measurement and correction of the performance of subordinates in order to make sure enterprise objectives and the plans devised to attain them are accomplished." [13, p. 639]

The purpose of this section will be to consider how the techniques of control which are described in the Department of Defense's <u>Integration of Planning for Production</u> and the Air Force Systems Command Manual 84-3, <u>Production Management</u>, apply to an overall production control process.

Koontz and O'Donnell describe the controlling process as consisting of three basic steps:

1. Establishing standards
2. Measuring performance against these standards
3. Correcting deviations [13, p. 640]

Measuring performance against standards is a comparison process from which deviations in performance are determined. Ideally, this measurement should be based on future status so that deviations may be identified in time to take preventive action. [13, p. 640] Correcting deviations involves switching performance back onto the planned track toward the accomplishment of objectives.

Military control requirements paralleling the control process just outlined by Koontz and O'Donnell can be summarized as follows:

1. Review
2. Surveillance and Testing
3. Negotiation

The Production Readiness Review (PRR) is described by the Air Force as having two main objectives: 1) to certify that the engineering design is complete, acceptable and capable of being produced in quantity; and 2) to certify that the contractor's planning for production is adequate and complete. [25, p. 3-4]

Production surveillance is described in the Military Standard Production Management Instruction as an effective operation which measures progress against plans. A surveillance effort should include identification and documentation of those factors which may affect schedule, cost or performance.

The function of testing, as previously discussed, has the objective of identifying and correcting production engineering practices which would otherwise lead to unsatisfactory materials, parts, subassemblies, and assemblies.

The project manager is further charged with resolving problems and analyzing proposals; and finally, in order to correct deviation from plans and eliminate faulty design, he is responsible for negotiating changes.

Cleland and King further define the principle of control as consisting of management and operational components:

> "Management control is oriented toward the achievement of objectives through control of activities and resources. Operational control focuses on the efficient and effective execution of specific tasks."[7, p. 409]

The application of this definition to the control requirement for the Production Readiness Review mentioned above suggests that approval of the production plan is equivalent to the establishment of management standards, and approval of engineering design is equivalent to the establishment of operational standards. When these analogies have been made, an integrated approach to the production control process emerges. Figure 7, "Techniques of the Control Process," relates the theoretical control process to the techniques of military production control as they are discussed in Air Force and Department of Defense Documents.

In summary, the process of control provides the means by which the project manager measures and corrects the performance of subordinates in order to make sure that production objectives, and plans devised to attain them, are accomplished.

Control Process	Techniques of Military Production Control
1. Establish standards	1. Establish surveillance organization relationships 2. Conduct Production Readiness Review 3. Receive favorable production decision (DSARC # 3)
2. Measure performance	1. Monitor the management control system a. plans b. programs c. schedules management progress 2. Monitor the operational control system a. design review b. testing c. quality assurance technical progress
3. Correct deviations	1. Resolve problems 2. Analyze proposals 3. Negotiate changes

TECHNIQUES OF THE CONTROL PROCESS

Figure 7

V. SUMMARY AND CONCLUSIONS

This study has attempted to show the applicability of the principles of planning, organizing, staffing, directing, and controlling to military production management. Although the preceding treatment of these principles was presented in discreet sections and did not specifically address the relationships, the project managers interviewed compromise and blend these principles to achieve the total desired result--effective and efficient production management. A summary of major conclusions drawn in this thesis, grouped by principle, follows.

A. PLANNING

The major areas requiring plans for the Production phase of defense systems acquisition are as follows:

1. Producibility analysis
2. Funding
3. Inspection and testing
4. Equipment and tools
5. Industrial support
6. Facilities
7. Personnel and training
8. Data
9. Configuration control
10. Fleet support

B. ORGANIZING

The major functional departments for management of the Production phase of defense systems acquisition are:

1. Business Management
2. Systems Engineering
3. Production Control
4. Quality and Testing
5. Fleet Support

Different project managers given the same objectives but possessing different backgrounds (categorized as technical, administrative or operational) will in all probability adjust the organization structure to coincide with their views on how to attain goals.

C. STAFFING

The objective of managerial staffing is to ensure that organizational functions are assigned to personnel who are willing and able to carry them out. The staffing process consists of several steps which together explain the method by which staffing is efficiently accomplished. They are:

1. Development--striving to improve managerial competence

2. Job definition--clear definition establishing need and incentives

3. Appraisal--related to objectives and quality of management

4. Promotion--opportunities existing inside and outside the organization

D. DIRECTING

To direct subordinates, project managers motivate communicate and lead. A manager should build a flexible system of motivation based on satisfying common needs and his experience. The vehicle supporting the directing principle is communications. In dealing with communication the needs of the organization are identified and communication barriers recognized. The three commonly accepted styles of leadership are autocratic, democratic and catalytic. With experience, a project manager can develop and adapt his style to the current situation.

E. CONTROLLING

The controlling process consists of three basic steps:

1. Establishing standards
2. Measuring performance against these standards
3. Correcting deviations

Figure 7, "Techniques of the Control Process," relates the theoretical control process to the techniques of military production control as they are discussed in Air Force and Department of Defense documents. Controlling provides the means by which the project manager corrects the performance of subordinates.

APPENDIX A

BUSINESS MANAGEMENT FUNCTIONS

- Principal advisor for the "business" aspects of the project

- Establish, maintain and coordinate all program plans

- Reviews operations and formulates plans for the use, development, installation and improvement of methods of planning, implementation and evaluation of program management systems and techniques, including PERT, PERT/COST, Work Breakdown Structures, milestone development, CSTCS and other procedures capable of providing information, data and status to the Program Manager.

- Assist in preparation of Program Change Requests (PCR)

- Responsible for initiating, planning, maintaining, controlling, coordinating and administering all aspects of program planning, reporting, budgeting and financial accounting

- Project advisor for all contractual and contract administration matters

- Contact point between the Procuring Contracting Officer (PCO) and the Administrative Contracting Officer (ACO)

- Responsible for development and update of the Advanced Procurement Plan (APP)

- Responsible for the administrative support of the project (supervise all clerical/administrative personnel)

- Readily available source for past and current program data

- Participate in ILS planning and implementation (member of ILS Management Team)

APPENDIX B

SYSTEMS ENGINEERING FUNCTIONS

- Direct the scientific and engineering aspects of the system to achieve stated program objectives

- Identify, ensure compatibility, and document intra-system and ship-system interfaces throughout the system life cycle (responsible for system engineering the weapon system)

- Plan, budget, coordinate and sponsor Engineering Change Proposals (ECP's) to achieve system performance in accordance with mission requirements. Approve only those ECP's that significantly improve the system performance (ECP's must be held to an absolute minimum in order to maintain the configuration base line)

- Review ECP's for their impact on schedule, cost, performance, producibility, logistics, system interfaces, operational effectiveness, reliability and maintainability

- Chairman of the Configuration Control Board

- Responsible for configuration control

- Develop requirements, techniques, equipments and procedures to assess system configurations for performance, readiness, reliability and maintainibility when integrated aboard ship

- Monitor preparation of and reviewing the technical data that establish configuration base lines

- Maintain current the technical data that define operational base lines based on approved ECP's including implementing their efforts on technical manuals and preventive and corrective maintenance documentation.

- Develop maintenance concepts and criteria for all levels of maintenance

- Review technical publications for completeness and adequacy of maintenance requirements for all levels of maintenance

- Participate in ILS planning and implementation (member of ILS Management Team)

- Integrate and coordinate the evolution of Standard Missile --2 with the Aegis System

- Monitor and assess performance of engineering functions by other activities to whom authority has been delegated

- Responsible for execution of the Value Engineering Program

- Monitor conversion of USS NORTON SOUND (AVM-1)

APPENDIX C

PRODUCTION CONTROL FUNCTIONS

- Analyze contract terms and specification requirements
- Review and evaluate the contractor's production plan
- Monitor the progress being made against the contractor's production plan and its relation to meeting contractual schedules
- Determine the scope and extent of production surveillance which will be conducted to assist in obtaining adequate and timely contract completion on the part of the contractor
- Recommend or take corrective measures to improve manufacturing situations or methods where potential or actual delays exist.
- Determine impact of ECP's on production and procurement (member of Configuration Control Board)
- Maintain configuration status accounts of product base lines including status of ECP's
- Performing and/or monitor acceptance tests
- Participate in ILS planning and implementation (member of ILS Management Team)
- Conduct producibility analysis to determine the methods of producing the system which will meet technical requirements within a specified time frame for an acceptable cost
- Responsible for all system production procurement functions including planning, budgeting, procurement and acceptance required for the implementation of the Weapon System Production Plan. (Above duties include: justifying budget planning, releasing procurement requests, providing program office assistance during negotiations, monitoring contractual progress, directing production assistance efforts, and handling contractual modifications required for the acceptance of the subject material.)
- Review the equipment, machinery, tools and fixtures to be used by the contractor during the production process (equipment and tools analysis)

- Determine the types of facilities necessary to house the production effort

- Work with the contractor to determine the skills, personnel and training requirements necessary to sustain the production effort

- Coordinate GFP/GFM/GFE through a designated GFE Officer to ensure timely arrival at contractor plant and onboard ship

APPENDIX D

QUALITY AND TESTING FUNCTIONS

- Identify and describe inspections and tests which assure that the manufacturing process produces equipment which meets system specifications

- Supervise development of integrated test plans designed to analyze and evaluate the validity of design, configuration, operations, reliability and maintainability during all phases of the system life cycle

- Develop criteria for system and subsystem tests to demonstrate achievement of mission and operational requirements

- Verify throughout the contract and up until the time of acceptance whether material, data, supplies and services conform to the contractual requirements and achieve satisfactory performance.

- Establish an effective Quality Control Program for the purpose of detecting, correcting and preventing defects

- Responsible for management, planning and implementation of the test and evaluation programs required to support the project, including TECH and OPEVAL and support of fleet firings thereafter (including budget coordination and liaison with contractor and Naval activities for testing and services)

- Direct testing program at the land based test site

APPENDIX E

FLEET SUPPORT FUNCTIONS

- Chairman of the Integrated Logistic Support Management Team

- Provide the planning and means for establishing a baseline for adequate logistic support to meet the needs of fleet introduction and operation

- Prepare and update the ILS Plan to identify <u>what</u> integrated logistic support activities will be accomplished, <u>who</u> will be responsible for their accomplishment, and <u>how</u> and <u>when</u> they will be accomplished

- Coordinate and monitor the implementation and execution of the ILS Plan across all disciplines in accordance with scheduled milestones

- Develop the logistic funding requirements

- Determine impact of ECP's on ILS (member of Configuration Control Board)

- Develop plans and determine requirements for trainers, simulators and related equipment

- Plan and direct weapon system fleet support program including ILS and fleet introduction

- Plan and monitor fleet requirements for maintenance support and establish programs to meet these requirements

- Implement plans for performing technical documentation, maintenance and associated fleet support

- Develop and implement plans for scheduling equipment and contractor maintenance support program

- Review and implement plans for ship conversion and installation

- Direct Fleet Introduction Officers assigned to each ship to coordinate the system installation

- Advise and assist ships' forces in correcting malfunctions and deficiencies

APPENDIX F

COMPUTER SYSTEMS FUNCTIONS

- Integrate each digital computer program with the hardware and/or function it is to prepare
- Integrate various computers (with their programs) into a single AEGIS Weapon System
- Serve as consultant on digital computers and their programming for the AEGIS Office

APPENDIX G

SPECIAL ASSISTANT FUNCTIONS

- Coordinate the interface with Navy, DOD and Congressional contacts
- Prepare briefings and special reports
- Prepare responses to GAO inquiries
- Assemble data for Congressional hearings
- Project marketing representative
- Crisis management

LIST OF REFERENCES

Books

1. Alford, L.P. and Bangs, J.R., Production Handbook, Ronald Press, 1947.

2. Asimow, M., Introduction to Design, Prentice-Hall, 1960.

3. Baumgartner, J.S., Project Management, Irwin, 1963.

4. Broom, H.N., Production Management, Irwin, 1962.

5. Buffa, E.S., Basic Production Management, Wiley, 1971.

6. Buffa, E.S., Modern Production Management, 3rd ed., Wiley, 1971.

7. Cleland, D.I. and King, W.R., Management: A Systems Approach, McGraw-Hill, 1972.

8. Cleland, D.I. and King, W.R., Systems Analysis and Project Management, McGraw-Hill, 1968.

9. Garett, J.W., Production and Operations Management, Harcourt, Brace and World, 1968.

10. Ginzberg, E. and Reilley, E.W., Effecting Change in Large Organizations, Columbia University Press, 1957.

11. Johnson, R.A., Kast, F.E., and Rosenzweig, J.E., The Theory and Management of Systems, McGraw-Hill, 1963.

12. Koontz, H. and O'Donnell, C., Management: A Book of Readings, 2nd ed., McGraw-Hill, 1968.

13. Koontz, H. and O'Donnell, C., Principles of Management, 4th ed., McGraw-Hill, 1968.

14. Koontz, H. and O'Donnell, C., Study Guide and Cases for Principles of Management, 4th ed., McGraw-Hill 1968.

15. Massie, J.L., Essentials of Management, 2nd ed., Prentice Hall, 1971.

16. Roman, D.D., Research and Development Management: The Economics and Administration of Technology, Appleton-Century-Crofts, 1968.

17. Sayles, L.R. and Chandler, M.K., Managing Large Systems-Organizations For the Future, Harper & Row, 1971.

18. Starr, M.K., Production Management-Systems and Synthesis, Prentice-Hall, 1964.

19. Voris, W., The Management of Production, Ronald Press, 1960.

Periodicals

20. Hartmann, G.K., "Development to Production," Ordnance Systems for National Defense, July-August 1969.

21. Reich, E.T., Vice Admiral, USN, "Ailments and Therapy In-The Process For Acquiring Major Weapons Systems," Defense Management Journal, v. VII, no. 1, Spring 1971.

22. Senger, J., "The Co-Mananager Concept," California Management Review, v. XIII, no. 3, Spring 1971.

23. Stoats, E.B., "GAO Looks At DOD Weapon System Acquisition Process," Defense Management Journal, v. 8, no 3, October 1972.

Reports

24. Aegis Weapons System Program Office, Technical Development Plan U17-06 R-1, 1 April 1971.

25. Department of the Air Force, Air Force Systems Command Manual, AFSCM 84-3, Production Management, 14 May 1971.

26. Department of Defense, Integration of Planning For Production (draft), December 1969.

27. Department of Defense, Military Standard Production Management During the Life Cycle of Systems and Equipment (draft).

28. Logistics Management Institute, Introduction to Military Program Management, LMI Task 69-28, March 1971.

29. Logistics Management Institute, The Program Manager Authority and Responsibilities, LMI Task 72-6, August 1972.

30. Naval Material Command Headquarters, Management of the Aegis Program by the RCA Corporation, March 1971.

31. Naval Ship Missile Systems Engineering Station (NSMSES) Brochure, Port Hueneme, California.

32. RCA Corporation, Shield of the Fleet, April, 1971.

Papers

33. Kline, M.B., Review of Management Principles, Lecture Notes.

34. Kline, M.B. and Lifson, M.W., Systems Engineering, UCLA Lecture Notes, April 1970.

35. RCA Corporation, Aegis Excellence Newsletter, v. 2, no. 2, August 1972.

Thesis

36. Brown, B.B., Jr., Captain, USN, Project Management Within the Naval Material Command, Industrial College of the Armed Forces, 1968.

37. Ralston, W.L. Commander, USN, An Evaluation of Project Management Practices in the Department of the Navy, Industrial College of the Armed Forces, 1968.

38. Strohlein, J., Defense Management Systems Management, Industrial College of the Armed Forces, 1968.

Instructions

39. Department of Defense Directive 4155.1, Quality Assurance, 9 February 1971.

40. Department of Defense Directive 5000.1, Acquisition of Major Defense Systems, 13 July 1971.

41. Department of Defense Directive 5010.19, Configuration Management, 17 July 1968.

42. NAVMAT Instruction 4000.20A, Integrated Logistic Support Planning Policy, 18 March 1971.

43. NAVORD Instruction 5000.5, Project Management in the Naval Ordnance Systems Command, 5 January 1970.

44. SECNAV Instruction 5000.1, System Acquisition in the Department of the Navy, 13 March 1972.

INITIAL DISTRIBUTION LIST

		No. Copies
1.	Defense Documentation Center Cameron Station Alexandria, Virginia 22314	2
2.	Library, Code 0212 Naval Postgraduate School Monterey, California 93940	2
3.	LT. J.R. Capra Department of Operations Research and Administrative Sciences Naval Postgraduate School Monterey, California 93940	1
4.	Professor J.W. Creighton Department of Operations Research and Administrative Sciences Naval Postgraduate School Monterey, California 93940	1
5.	LCDR. R.H. Bergman c/o ISRAEL 203 Patuxent Road Laurel, Maryland 20810	1
6.	LT. S.S. Israel 203 Patuxent Road Laurel, Maryland 20810	1
7.	Department of Operations Research and Administrative Sciences Naval Postgraduate School Monterey, California 93940	1

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

ORIGINATING ACTIVITY (Corporate author) Naval Postgraduate School Monterey, California 93940	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

REPORT TITLE

Project Management for the Production Phase of System Acquisition

DESCRIPTIVE NOTES (Type of report and, inclusive dates)

Master's Thesis; March 1973

AUTHOR(S) (First name, middle initial, last name)

Richard H. Bergman, Lieutenant Commander, Supply Corps, USN
Stephen S. Israel, Lieutenant, USN

REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
	64	44

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO.	
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Naval Postgraduate School Monterey, California 93940

13. ABSTRACT

Military project management for the Production phase of system acquisition is discussed. A management framework based on analysis of five principles--planning, organizing, staffing, directing, and controlling--is constructed. Organization alternatives for production management are proposed to the Aegis Weapon System Project Manager, who sponsored this research. The results of this analysis indicate that when a project manager's background is categorized as being operational, administrative or technical, significant conclusions can be drawn concerning the characteristics of the project manager best suited to manage the Production phase and the structure of his Production organization. Investigation also revealed that the primary functions of military project organizations in the Production phase of system acquisition are: Business Management, Systems Engineering, Production Control, Quality and Testing, and Fleet Support. Departmentation along these functional lines during the Production phase of system acquisition appears to reflect the economic division of work in the military project organization.

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Project Management						
Production						